UX Design Principles and Guidelines

SWEN-444

Achieve Usability Goals

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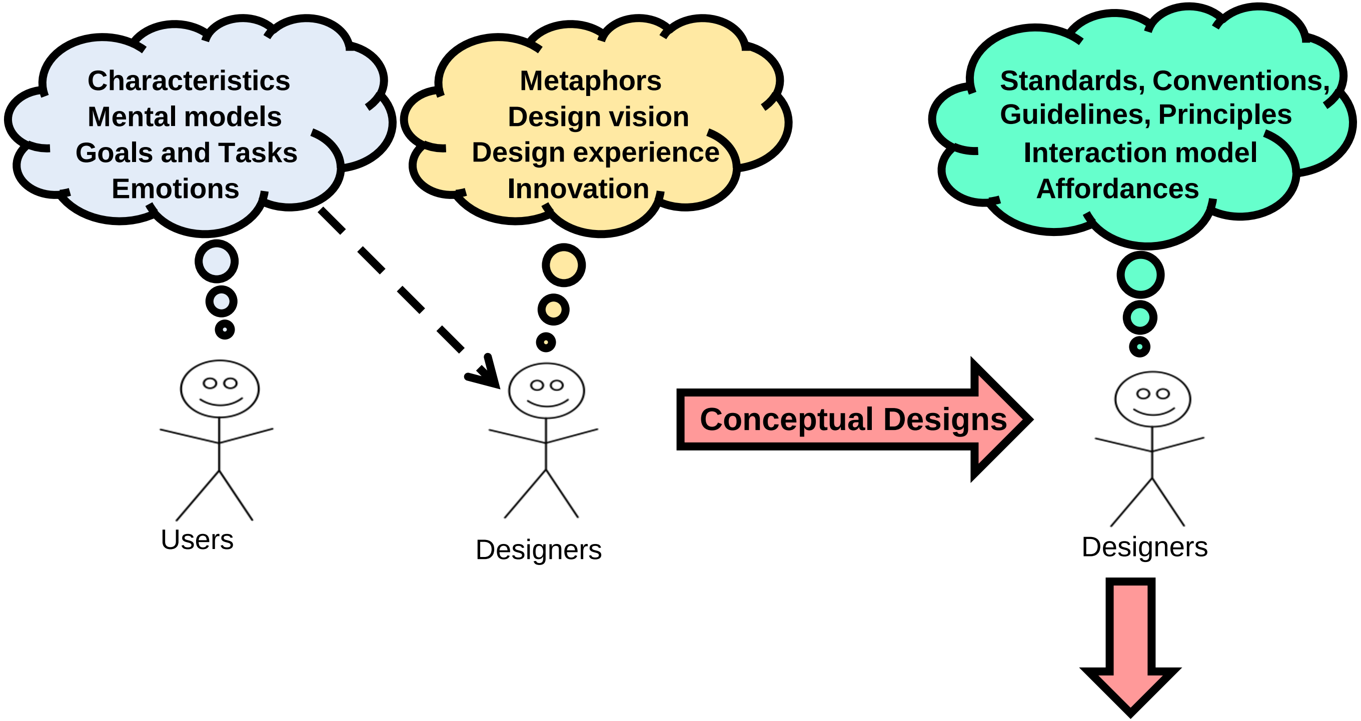
Design Thinking



Characteristics
Mental models
Goals and Tasks
Emotions

Metaphors
Design vision
Design experience
Innovation

Standards, Conventions,
Guidelines, Principles
Interaction model
Affordances

Users

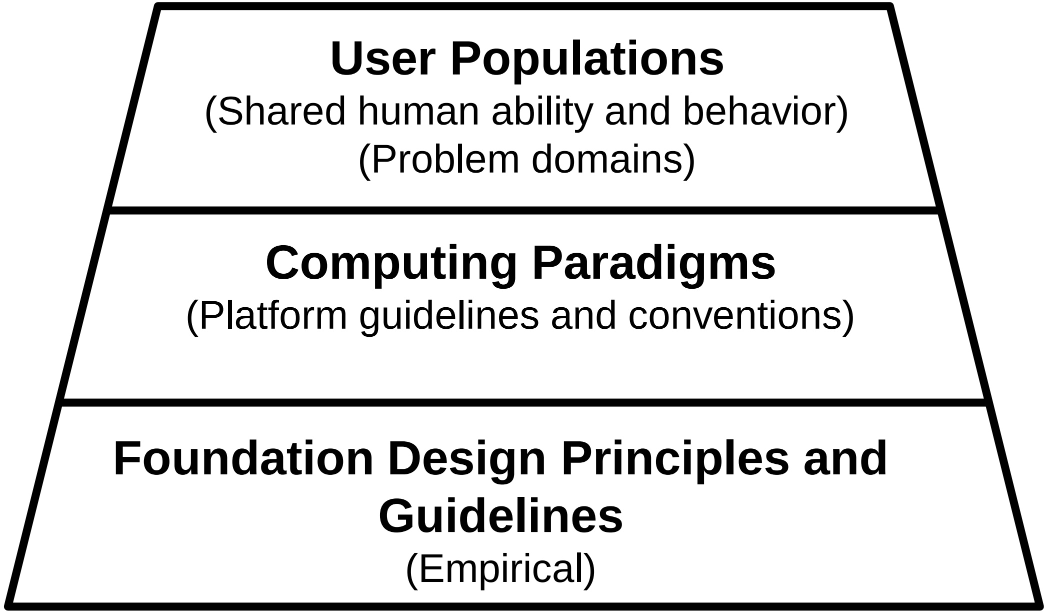
Designers

Conceptual Designs

Designers

Intermediate and Detailed Designs

Design Principles and Guidelines

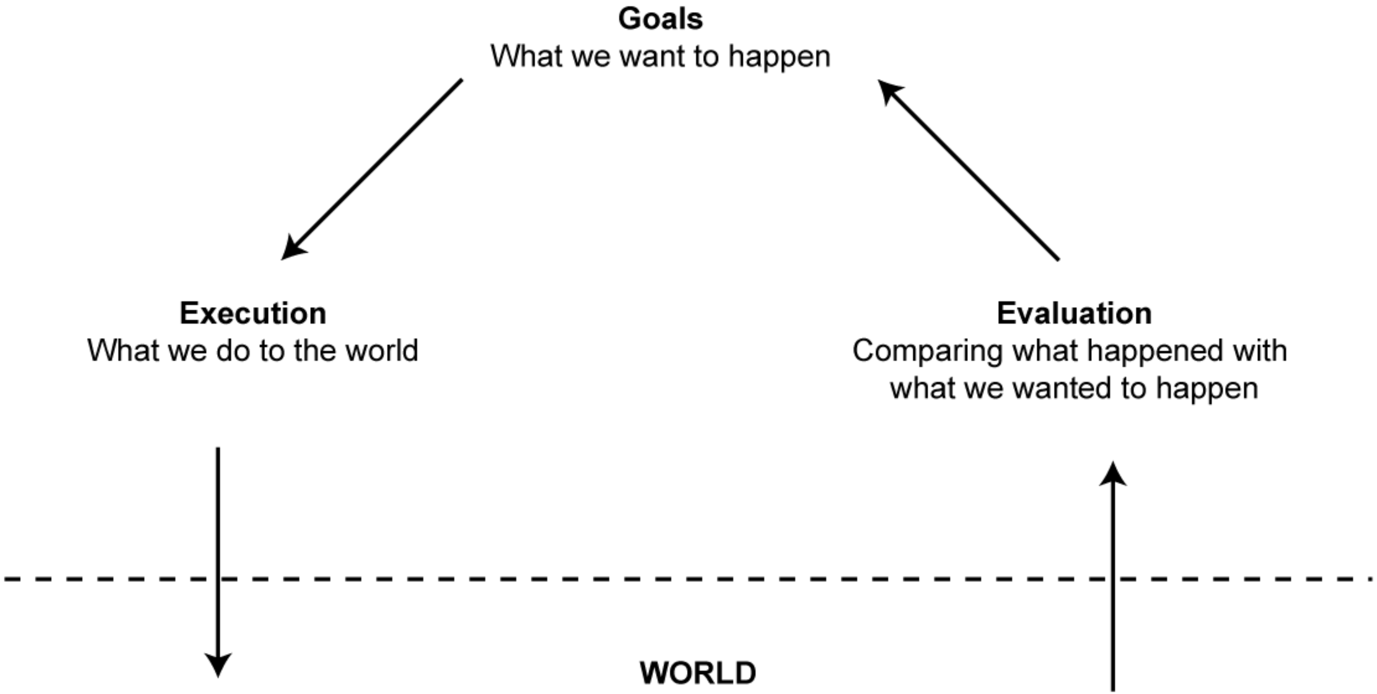


User Populations
(Shared human ability and behavior)
(Problem domains)

Computing Paradigms
(Platform guidelines and conventions)

Foundation Design Principles and Guidelines
(Empirical)

Norman’s Interaction Model
Execution/Evaluation Action Cycle



Goals
What we want to happen

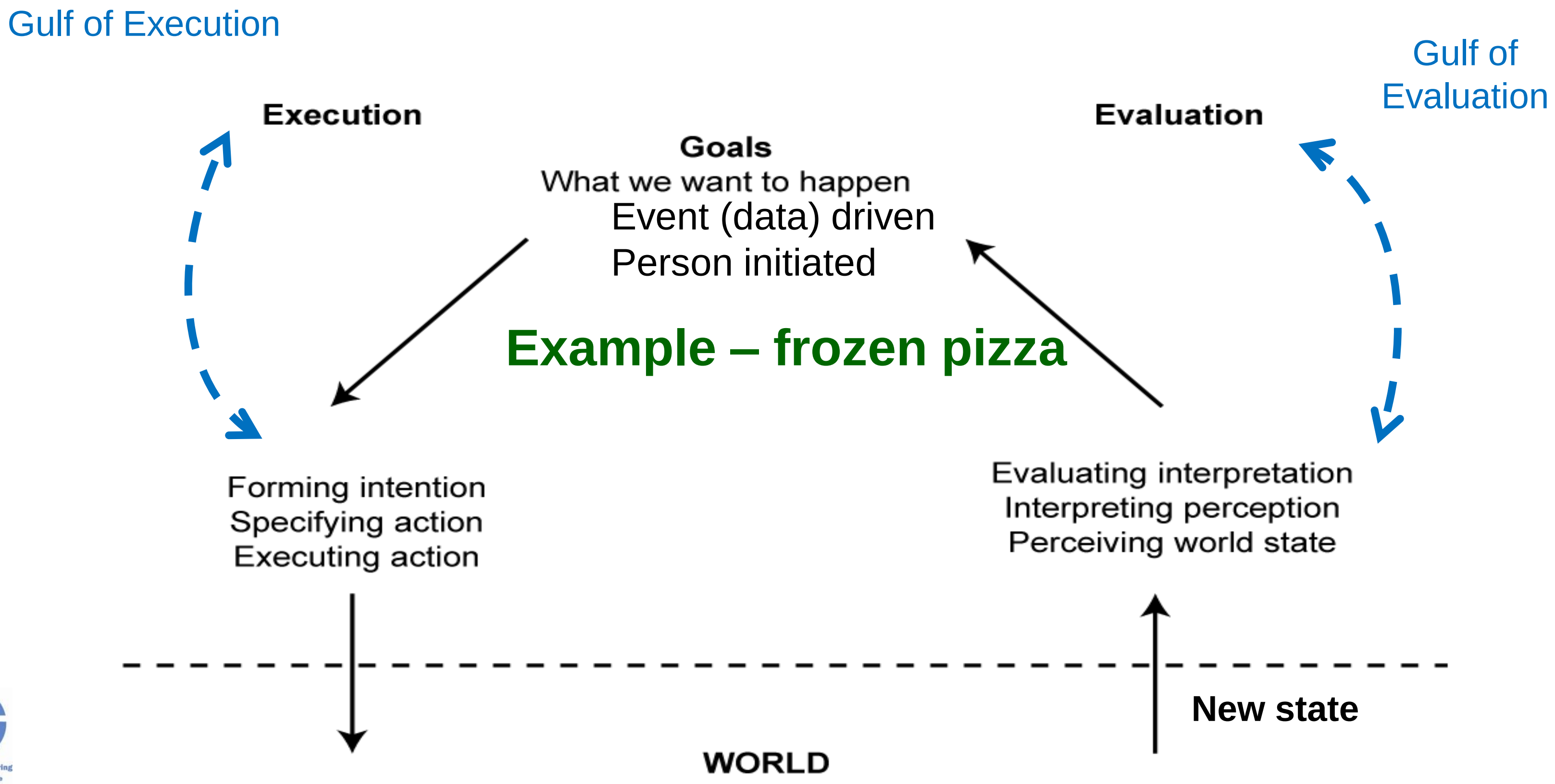
Execution
What we do to the world

Evaluation
Comparing what happened with what we wanted to happen

WORLD

Donald Norman, *The Design of Everyday Things,* 1990

Execution/Evaluation Action Cycle: Stages of Action



Gulf of Execution

Gulf of Evaluation

Execution

Evaluation

Goals
What we want to happen

Event (data) driven
Person initiated

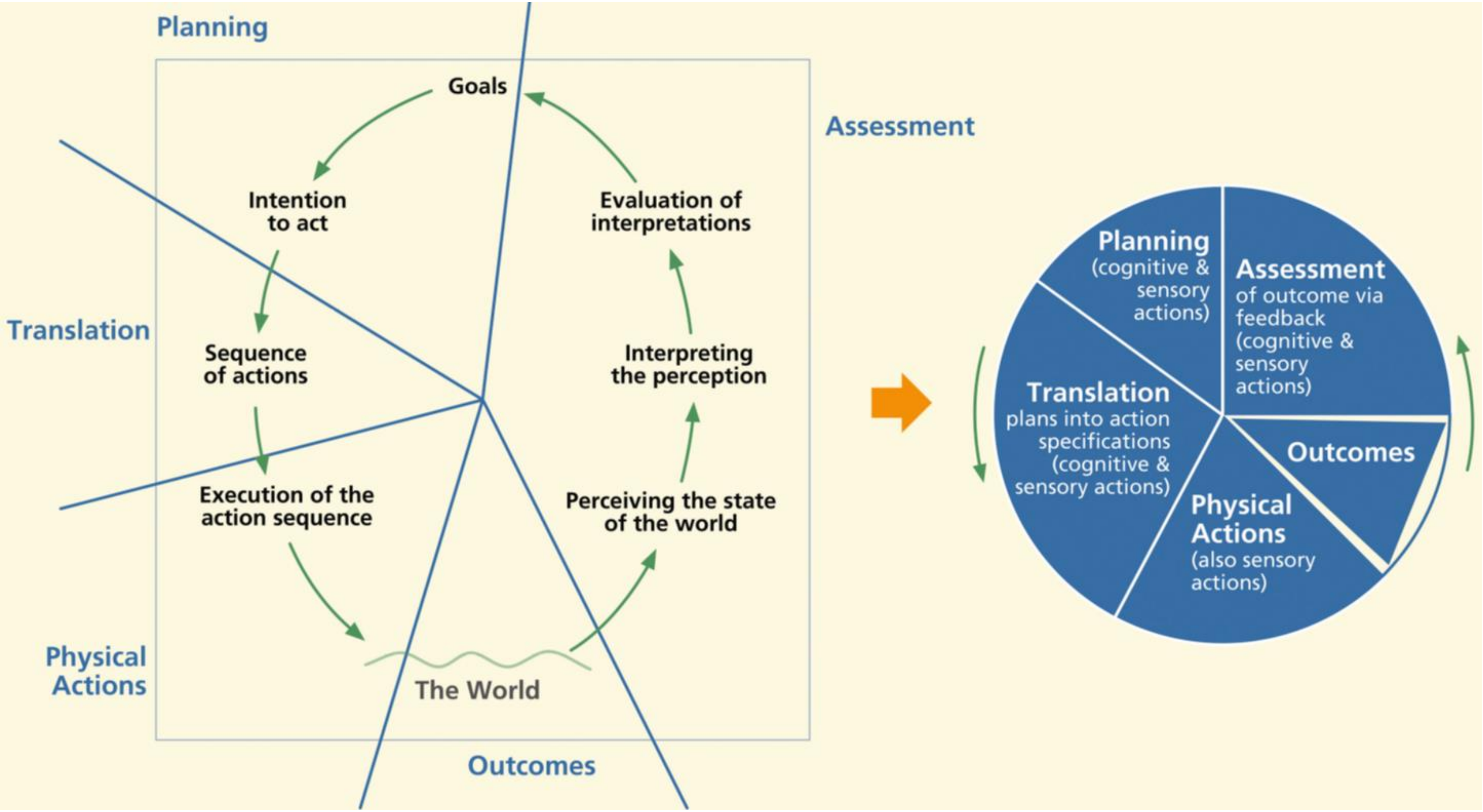
Example – frozen pizza

Forming intention
Specifying action
Executing action

Evaluating interpretation
Interpreting perception
Perceiving world state

New state

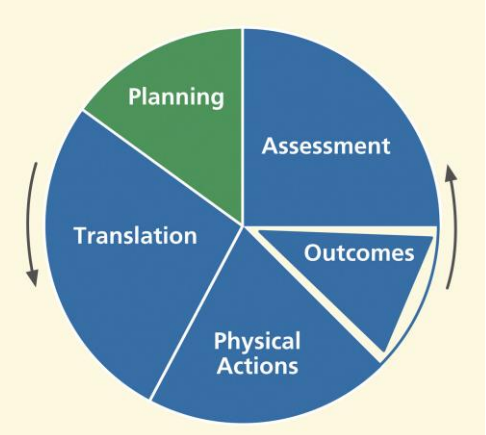
WORLD


Planning
Goals
Assessment
Intention to act
Evaluation of interpretations
Translation
Sequence of actions
Interpreting the perception
Execution of the action sequence
Perceiving the state of the world
Physical Actions
The World
Outcomes
Planning (cognitive & sensory actions)
Assessment of outcome via feedback (cognitive & sensory actions)
Translation plans into action specifications (cognitive & sensory actions)
Outcomes
Physical Actions (also sensory actions)

Framework to structure UX design principles and guidelines

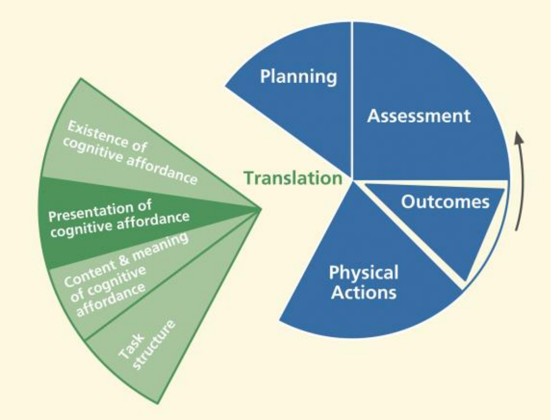
Planning – Help Users Know *What* to Do

- Support user’s overall understanding of **design concept** (mental model and metaphors)
    - Task organization and decomposition
- What system **features** exist and how to use them
- **Possibilities** for what users can do at every point
- Help users **plan** most efficient ways to complete tasks
- Keep users **aware** of **system state** and task **progress**
- Provide cognitive affordances to **remind** users to complete tasks



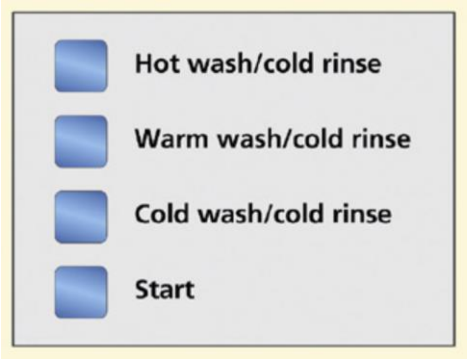
Translation: Help Users Know *How* To Do Something

- Effective **cognitive affordances** to complete tasks
  - Users determine how to get started
  - Users know/learn what actions are needed to perform next
  - Help users predict the outcome of actions
  - Users reminded to complete all actions
- Cognitive affordances are **noticeable**(location), **visible, and legible**
- **Timely**, before associated exploit


Planning
Assessment
Translation
Outcomes
Physical Actions
Existence of cognitive affordance
Presentation of cognitive affordance
Content & meaning of cognitive affordance
Task structure

Translation: Content and Meaning of Cognitive Affordance

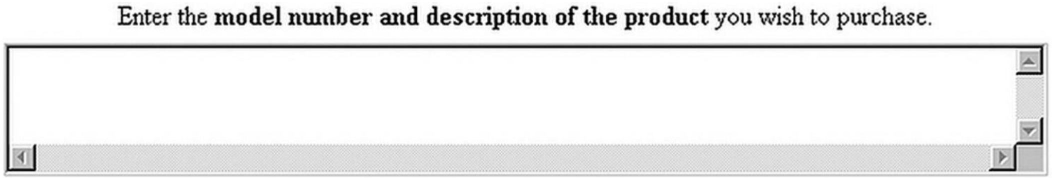
- Use **precise** wording and naming for clarity in labels, menu titles, menu choices, icons, data fields
  - E.g., complete labels by using a noun and a verb
- Make **choices distinguishable** but consistent
  - Similar (different) names for similar (different) kinds of things
    - Avoid multiple synonyms for the same thing (e.g., “quit”, “exit”, “close”)
  - Similar (different) object appearance for similar (different) kinds of things



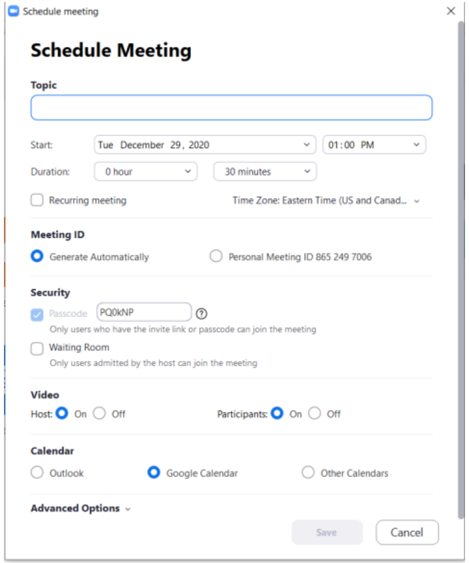
Consistency problem(s)?

Translation: Content and Meaning of Cognitive Affordance

- Control complexity with object **proximity** and **grouping**
  - By related tasks and functions (more on this later)
- **Recognition over recall**
  - Recognition: remembering with the help of a visual clue
  - Recall: remembering with no help
  - Recognition is much easier



Enter the **model number and description of the product** you wish to purchase.



Schedule meeting

Schedule Meeting

Topic

Start: Tue December 29, 2020 01:00 PM

Duration: 0 hour 30 minutes

□ Recurring meeting Time Zone: Eastern Time (US and Canad...

Meeting ID

● Generate Automatically ○ Personal Meeting ID 865 249 7006

Security

☑ Passcode PQ0kNP

Only users who have the invite link or passcode can join the meeting

□ Waiting Room

Only users admitted by the host can join the meeting

Video

Host: ● On ○ Off Participants: ● On ○ Off

Calendar

○ Outlook ● Google Calendar ○ Other Calendars

How We Remember Things

- **Knowledge in the world**
  - Intrinsic **properties** of **real objects** act as perceivable **cues**
  - Environment **interpretation** rather than learned
  - E.g., keyboard typing
- **Knowledge in the head**
  - Must be **recalled** from **short** and/or **long term memory**
  - May require **significant effort**, may be inaccurate
  - E.g., spelling a word
- They **work together**

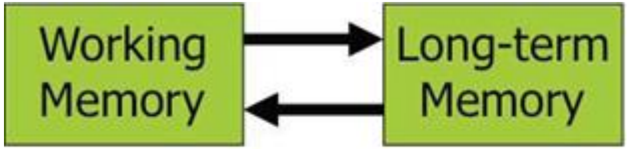
Stages of Learning

Stages	Behaviors	Moods
Beginner	Limited or no knowledge	Ambition to learn, but fear of failure, impatient
Advanced Beginner	Familiarity with common situations, still needs help	Ambition but potential boredom or apathy
Competent	Has learned the norms for common situations unassisted	Confidence but anxiety, insecurity, frustration
Proficient	High level of skill, new standards of performance	Ambition, confidence but impatience, frustration, arrogance
Expert	Extensive experience, teaches others	Ambition, confidence and serenity but arrogance and impatience
Master	Big picture view, can make change happen to improve	Ambition, exploration but arrogance, boredom, disinterest

“A five-stage model of the mental activities involved in directed skill acquisition”, Dreyfus, 1980

Translation: Design for Learnability, Memorability and Human Memory Limitations

- Don’t assume because the interface tells the user something, they learn and remember it
- Working memory
  - Small 7 ± 2 **chunks**
  - <10 sec decay
  - Rehearsal can impact decay
- Long term memory
  - Infinite in size and duration
  - Extensive rehearsal transfers chunks
- **Chunk data**; chunk is a unit of memory or perception
  - Hard: M W B C R A L O A B I M B F I
  - Easier: MWB CRA LOA BIM BFI
  - Easiest: BMW RCA AOL IBM FBI
- **Stacking** – task interruptions, limit depth



Design to avoid overloading working memory

Translation: Design for Understandability

Human Errors

- **Slips and Lapses** - **failure** to execute a **learned task**
  - Slip: action not carried out as intended or planned
  - Lapse: missed actions and omissions due to short term memory failure - Interruptions, loss of intent
  - Typically found in skilled behavior
  - Most common human error – due to inattention
- **Mistakes** - use the **wrong task**
  - A type of error caused by a faulty plan/intention
  - Typically found in rule-based or problem-solving behavior

Translation: Design for Understandability

Error Prevention

- Different things should look and act differently
- **Risky** (consequential, hard to recover from errors) **actions** are **separated** from frequently used ones
- **Avoid lapses** – keep task steps short, include forcing functions that require a sequence of steps (trade off of user freedom)
- **Disable illegal commands**
- **Avoid** using **modes**
- To prevent costly errors, **solicit user confirmation** before potentially destructive actions
  - Information on alternatives
  - But do not overuse and annoy

Translation: Task Efficiency

- Provide **alternative** ways to perform tasks
- Provide keyboard **shortcut** alternatives to avoid physical “switching” actions
- **Task thread continuity**
  - Anticipate most likely next text, step, or action
  - If you tell them what they should do, help them get there
- Do not make user **redo** any work, **reenter** data

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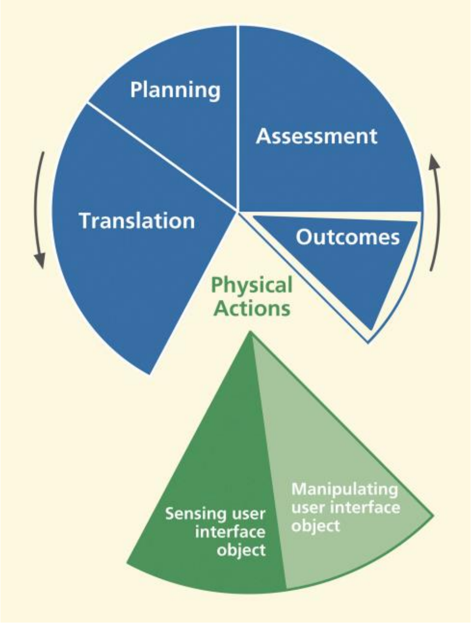
Translation: Task Efficiency

- **Retain** user **state** information
  - – Example, having to find folder you are working in, over and over
- ***Keep the user in control***
  - – Good interfaces are **explorable**, errors are forgiven
  - – Avoid too much **automation**
  - – Provide a way for the user to “**bail out**” of an operation
  - – Clear “**do it**” mechanism
  - – A way to **control** the amount and detail of complex **information/data feedback**
- **3-Click-Rule** – users should not have to wait longer than three clicks to do something useful

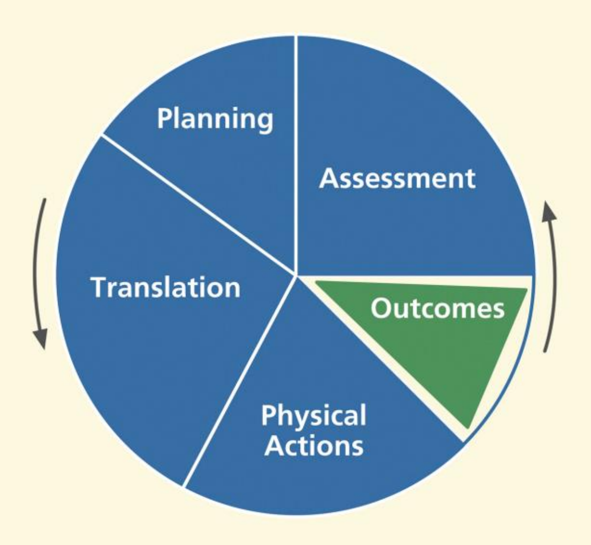
Physical Actions: Help Users Do Tasks

- Necessary **physical affordances** for manipulating UI objects, making physical actions
- Effective **sensory** affordances **before** and **during** actions (e.g., drag and drop)
- Avoid physical **awkwardness** and **fatigue**; e.g., shifting from mouse to keyboard constantly
- Accommodate **disabilities**
  - Range of motion, fine motor control, vision, or hearing
  - (More on this later)
- **Fitts' law** – target size and distance; avoid overshoot


Planning
Assessment
Translation
Outcomes
Physical Actions
Sensing user interface object
Manipulating user interface object

Outcomes

- **Internal**, invisible system **effect/result**
  - Possible defects due to missing features, computational errors, software bugs
- **Functional affordances** of system functionality (usefulness)
- Outcomes must be revealed to user via **system feedback**
- Show **automation success**; e.g., GPS accuracy



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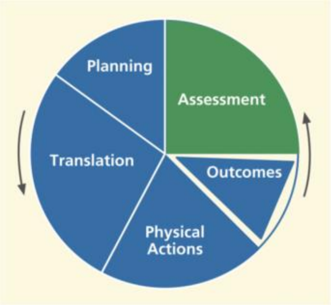
Outcomes: Design for Efficiency - Performance

- **Perceptual fusion** – two stimuli within perceptual cycle appear fused; T_p ~100 msec
- **Response times:**
  - ≤ 100 msec – instantaneous
  - 0.1 – 1.0 sec – user notices the delay, flow of thought may be interrupted
  - 1.5 sec – display busy indicator
  - >1.5 sec – display progress bar
  - > 10 sec – may lose user’s attention
- **2-Second-Rule:** users should not have to wait longer than 2 seconds for common UI actions

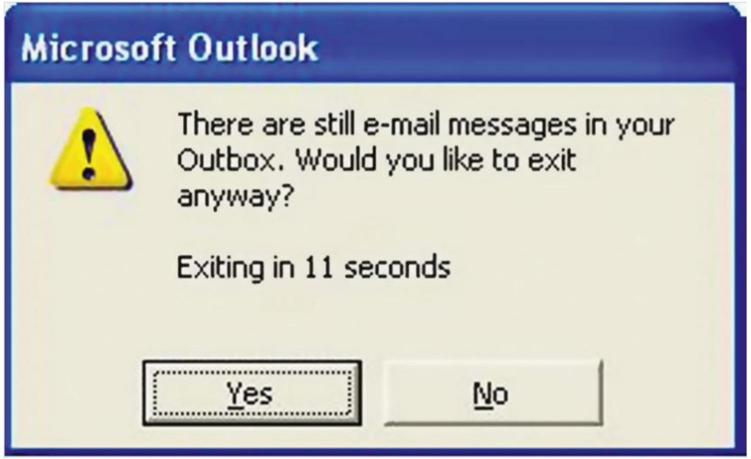
Assessment: Help Users Know if Interaction Was Successful

- Provide some type of **feedback** for all user actions
  - Helps keep the user grounded in the interactive cycle
  - Understandable timely **error messages** when things don't work
  - **Progress feedback** on long operations
- **Presentation** of feedback
  - Visible, legible, noticeable location
  - Minimize complexity with organized layout
  - Responsive design – fit information format to screen size
- **Meaning** of feedback content in context of system state



Assessment

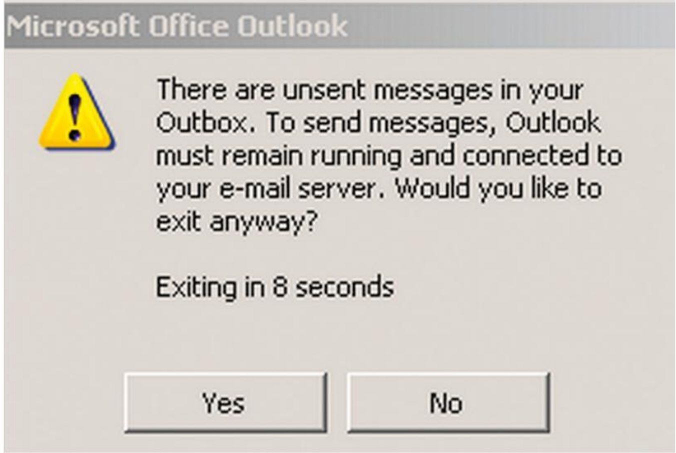
- Feedback wording
  - Helpful, informative
  - Positive psychological tone; it’s the system’s fault
  - Language of the user and domain context



Microsoft Outlook

There are still e-mail messages in your Outbox. Would you like to exit anyway?

Exiting in 11 seconds

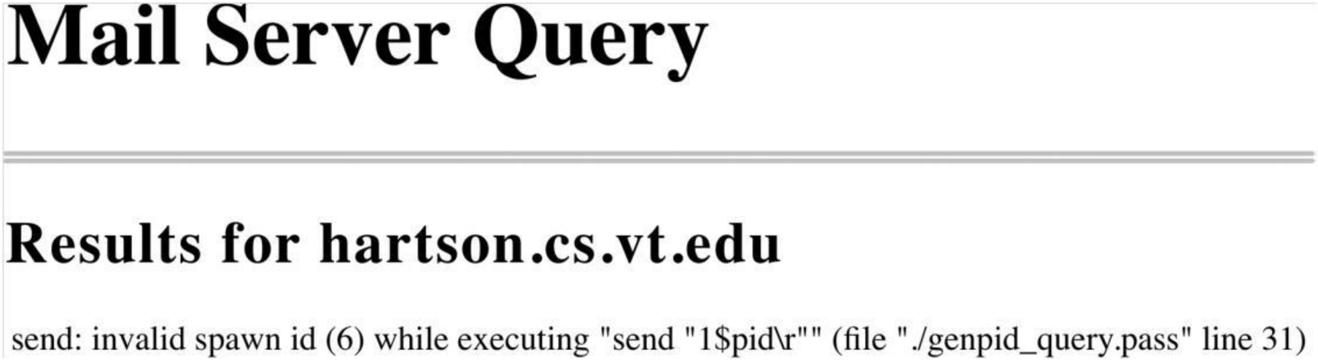


Microsoft Office Outlook

There are unsent messages in your Outbox. To send messages, Outlook must remain running and connected to your e-mail server. Would you like to exit anyway?

Exiting in 8 seconds

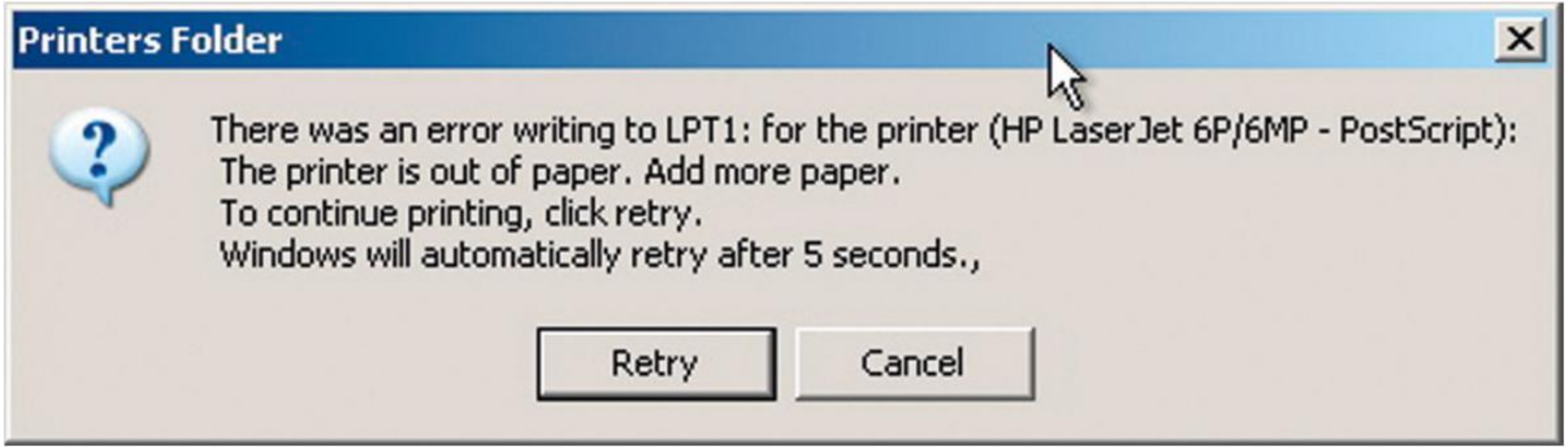
Assessment



Mail Server Query

Results for hartson.cs.vt.edu

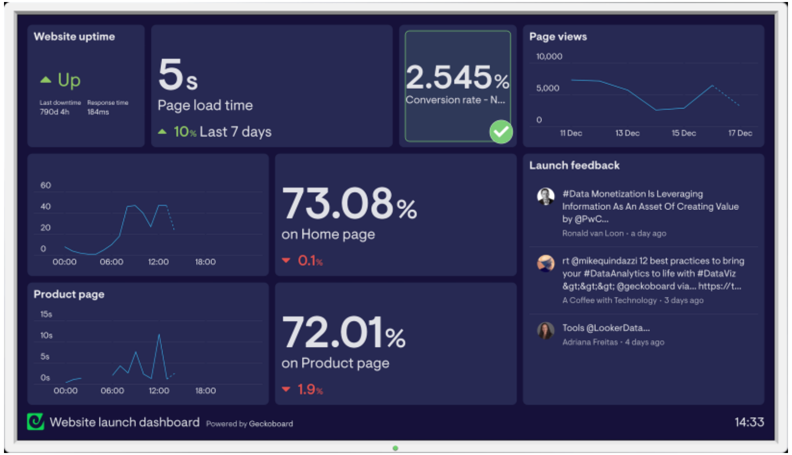
```
send: invalid spawn id (6) while executing "send "1$pid\r"" (file "./genpid_query.pass" line 31)
```



There was an error writing to LPT1: for the printer (HP LaserJet 6P/6MP - PostScript):
The printer is out of paper. Add more paper.
To continue printing, click retry.
Windows will automatically retry after 5 seconds.,

Assessment – Information Visualization

- **Represent “raw" data visually** to help the user understand data meaning
  - Intuitive comprehension to “see” patterns, trends, outliers, etc., in large data sets
  - E.g., dashboards, charts
- What does the **user need to know** in the context of the application domain?



#Data Monetization Is Leveraging Information As An Asset Of Creating Value by @PwC...
Ronald van Loon · a day ago

rt @mikequindazzi 12 best practices to bring your #DataAnalytics to life with #DataViz &gt;&gt;&gt; @geckoboard via... https://t...
A Coffee with Technology · 3 days ago

Tools @LookerData...
Adriana Freitas · 4 days ago

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Broad Guidelines:

- **Simplicity**
  - Given two otherwise equivalent designs, the simplest is best (Ochham's Razor)*
  - Good enough - effective and simple is a challenging design objective
  - 80/20 rule – 20% of functionality gets used 80% of the time
  - 7 +/- 2 maximum number of vertical/horizontal divisions on a screen
- **Consistency**
  - Do similar things in different places the same way
  - Label similar things the same
  - A custom design style book can help

* "Entities should not be multiplied without necessity." William of Ockham, 14th century Franciscan friar

Broad Guidelines

- Use of language
  - Avoid poor attempts at humor
  - Avoid use of anthropomorphism
  - Avoid using first-person speech
  - Avoid condescending help (E. g., Clippy and Bob)
  - Use positive psychological tone
  - Avoid violent, negative, demeaning terms
  - Avoid use of psychologically threatening terms, such as “illegal,” “invalid,” and “abort”
  - Avoid use of term “hit”; instead use “press” or “click”

- More later on …
  - Grouping
  - Color
  - Text
  - Accessibility
  - Platform conventions
  - Internationalization

The Last Word – Using Guidelines

- Thoughtfully **interpret guidelines** in the context of your design problem
- They are a “guide” **not mandated** design rules
- However, they are **universally applicable** to many technology platforms
- Guidelines may **conflict and overlap**
- Guidelines **don’t guarantee** a quality UX
- The underlying principles **don’t change** over time even as technology does

Team Activity

Work on the detailed design of your project, make sure to follow the UX guidelines during the whole Execution/Evaluation Action Cycle :

1. Planning:
2. Translation:
3. Physical Actions
4. Outcomes
5. Assessment

Appendix

Principles and Guidelines Reference

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Planning – Design for Understandability

Match user’ s **mental model** of high-level task organization
What system **features** exist, what users can do at every point
Help users **plan** how to **complete tasks efficiently**
Keep users aware of **task progress**
Task completion reminders

Translation

Content and Meaning of Cognitive Affordance

Timely and **visible** cognitive affordances
Precise wording and naming
Make **choices distinguishable but consistent**
Avoid multiple synonyms for the same thing
Control complexity with **object proximity and grouping**
Recognition over recall **Recognition**: remembering with the help of a **visual clue** **Recall**: remembering with **no help**

Understandability: Error Prevention

Avoid Inappropriate and Erroneous User Choices

Disable buttons, menu choices to make **inappropriate choices unavailable** or **gray** out to make inappropriate choices ***appear*** **unavailable**
Different things should look and act differently
Separate risky (consequential, hard to recover from errors) **actions** from **frequently used** ones
Solicit user **confirmation** before potentially destructive actions; **risk** of user **annoyance**
Avoid memory lapses – short task steps, consider imposing a **required sequence of steps** (trade off of user freedom)
Avoid modes entirely, don't duplicate actions across modes
Provide cognitive affordances for **error recovery** Provide a clear way to **undo** and reverse actions Offer constructive **help** for error recovery

Translation (cont)

Task Efficiency

Provide **alternative ways** to **perform tasks**; e.g., keyboard alternatives to avoid physical switching actions
Task thread continuity - anticipate most likely next action, step, or task path
Do **not** make user **redo** any work, **reenter data**
Retain user **state** information Example, having to find folder you are working in, over and over
Keep the user in control Good interfaces are explorable, errors are forgiven
3-Click-Rule – users should not have to wait longer than three clicks to do something useful

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Physical Actions

Help Users Do Tasks

Physical affordances for sensing and manipulating UI objects for and during **making physical actions**

Avoid physical **awkwardness** and **fatigue**; e.g., shifting from mouse to keyboard constantly

Accommodate disabilities

- Range of motion, fine motor control, vision, or hearing

Fitts’ Law issues

Outcomes

Internal, invisible system effect/result

Functional affordances of system functionality (usefulness)

Outcomes must be revealed to user via **system feedback**

Show **automation success**; e.g., GPS accuracy

Response times:

- < 100 msec – **perceptual fusion** as two stimuli appear to be **instantaneous**
- 0.1 – 1.0 sec – user notices the delay
- 1.5 sec – display busy indicator
- >1.5 sec – display progress bar

2-Second-Rule: users should not have to wait longer than 2 seconds for common UI actions

Assessment

Provide some type of feedback for all user actions
Presentation of feedback – **visible, noticeable** location; augment with audio
Understandable error messages when things don’t work
Progress feedback on **long operations**
Feedback wording Helpful, informative Positive psychological tone; it’s the system’s fault Language of the user and domain context
Feedback consistency – label d**eparture** and **destination** screens **consistently**

Presentation

Provide **user control** over **amount** and **detail** of **feedback**; most **important** information at **first**, more on demand

Information display

- Eliminate **unnecessary words**
- **Group** related information
- Control density of displays; use **white sp**ace to set off
- **Columns are easier** to read than wide rows (see newspapers)
- **Responsive design** – format information to fit the screen size (more on this later)
- **Visualization** for large data sets

Broad Guidelines

Given two otherwise equivalent designs, the **simplest is best** (Ochham's Razor)* A design challenge.
80/20 rule – 20% of functionality gets used 80% of the time
Good enough – choose a **satisfactory** solution **rather than** the **optimal** solution; avoid complexity
7 +/- 2 maximum number of vertical/horizontal divisions on a screen
Consistency - label and **do similar things** in **different places** the **same way**
Use of **language** – avoid use of **poor humor**, **anthropomorphism, first person speech**, **condescending** and other **psychologically negative words** (e.g., violent, demeaning, threatening)

* "Entities should not be multiplied without necessity." William of Ockham, 14th century Franciscan friar